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मानक

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Mazdoor Kisan Shakti Sangathan

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“पुराने को छोड़ नये के तरफ”

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“Step Out From the Old to the New”

IS 14194-2 (1994): Radionuclides in environmental samples - Method of estimation, Part 2: Gross alpha activity measurement [CHD 30: Nuclear Materials]



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“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

पर्यावरण नमूनों में रेडियोन्यूक्लाइड्स —
आँकलन की पद्धतियाँ

भाग 2 सकल एल्फा सक्रियता मापन

Indian Standard

RADIONUCLIDES IN ENVIRONMENTAL
SAMPLES — METHODS OF ESTIMATION

PART 2 GROSS ALPHA ACTIVITY MEASUREMENT

UDC 614.876 : 539.164

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

FOREWORD

This standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Nuclear Materials Sectional Committee had been approved by the Chemical Division Council.

Long lived gross alpha activity of air filter sample can be used to detect any air contamination especially plutonium (Pu). In case of water samples, gross activity determined by evaporation of an aliquot can indicate the trend of contamination specially for the waters receiving wastes from fuel reprocessing plant. Keeping in view this fact the committee decided to formulate this standard.

Composition of the committee responsible for formulation of this standard is given at Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

RADIONUCLIDES IN ENVIRONMENTAL SAMPLES — METHODS OF ESTIMATION

PART 2 GROSS ALPHA ACTIVITY MEASUREMENT

1 SCOPE

This standard prescribes the method of test for measurement of gross alpha activity in the environmental samples.

2 REFERENCES

The following Indian standards are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
264 : 1976	Nitric acid (<i>second revision</i>) (Reaffirmed in 1990)
265 : 1993	Hydrochloric acid (<i>fourth revision</i>)
1070 : 1992	Water for general laboratory use (<i>third revision</i>)
10332 : 1982	Hydrofluoric acid, aqueous (Reaffirmed in 1992)

3 TERMINOLOGY

3.1 For the purpose of this standard the following terms shall apply.

3.1.1 Activity

The number of spontaneous nuclear disintegrations occurring in a given quantity of material during a suitably small interval of time divided by that interval of time. It is commonly expressed in Becquerel (Bq), formerly expressed in Curies.

NOTE — Sometimes used to designate a quantity of radionuclide. (Also called disintegration rate.)

3.1.2 Nuclide

A species of atom characterized by its mass number, atomic number and nuclear energy state, provided that the mean life in that state is long enough to be observable.

3.1.3 Radionuclide — A radioactive nuclide.

4 PRINCIPLE

Alpha activity of the sample (either air filter or sample evaporated on a stainless steel planchet) prepared, is directly measured with an alpha counter having zinc sulphide-silver scintillation detector.

5 APPARATUS

5.1 Alpha Counting System — with sample holder capable of taking stainless steel planchets. The background counts shall be less than 5 counts per minute and efficiency better than 20 percent.

5.2 Stainless Steel Planchet — of 0.5 mm thick and 25 mm in diameter.

5.3 Infra Red Lamp — of 500 W.

6 PROCEDURE

6.1 Air Filter for Long Lived Alpha Activity

6.1.1 Collect air particulate sample on millipore or glass fibre or Whatman 40 filter paper of 25 mm diameter placed in the air sampler. Filter about 5 m³ of air. Count the filter paper in the alpha counter after allowing the short lived radon daughter products to decay. Calculate the activity per cubic metre of air.

6.2 Water Samples with Low Total Dissolved Solids (TDS)

6.2.1 If the water sample has dissolved solids less than 100 mg/l, evaporate 10 ml of sample to near dryness in a small beaker.

6.2.2 Transfer the sample to a stainless steel planchet using a dropper attached to a rubber teat. Use a few drops of distilled water for the complete transfer of the contents of the beaker.

6.2.3 Evaporate under infra-red lamp and flame the planchet to a red hot conditions. Then cool and count for alpha activity by the alpha counting system.

6.3 Water Samples with High Total Dissolved Solids

6.3.1 Reagents

6.3.1.1 Bismuth (Bi) carrier made from bismuth nitrate [Bi(NO₃)₃] (50 mg Bi/ml).

6.3.1.2 Phosphoric acid concentrated

6.3.1.3 Lanthanum (La) carrier prepared from lanthanum nitrate [La(NO₃)₃] (1 mg La/ml).

6.3.1.4 Hydrofluoric acid, concentrated

6.3.1.5 Hydrofluoric acid — nitric acid wash solution — 5 ml hydrofluoric acid and 5 ml nitric acid and diluted to 1 litre with distilled water.

6.3.2 Alpha Background Activity Determination

6.3.2.1 Take 1 ml lanthanum carrier in a polythene centrifuge tube. Dilute to 5 ml with 4 N hydrochloric acid.

6.3.2.2 Add 1 ml of concentrated hydrofluoric acid, stir with a teflon rod, centrifuge and discard the supernate.

6.3.2.3 Wash the precipitate with hydrofluoric acid-nitric acid wash solution.

6.3.2.4 Wash the precipitate with 5 ml of distilled water and transfer the precipitate to a stainless steel planchet using a dropper attached to a rubber teat. Use drops of distilled water for slurring.

6.3.2.5 Dry the stainless steel planchet under an infrared lamp, after spreading the slurry on the planchet with a pointed glass rod.

6.3.2.6 Flame the stainless steel planchet, cool and count in the alpha counter and record the lanthanum fluoride background count rate (N_{LaF_3}).

6.3.3 Alpha Activity Determination of Sample

6.3.3.1 Take 1 litre sample and add 5 ml of concentrated nitric acid and 500 mg of bismuth carrier with stirring. Then add 1 g hydroxylamine hydrochloride and stir again.

6.3.3.2 Warm on a hot plate and add 1 ml of phosphoric acid with stirring. Allow to cool. Bismuth phosphate gets precipitated along with most of the alpha emitters.

6.3.3.3 Discard the supernate, collect all the precipitate in a plastic centrifuge tube.

6.3.3.4 Dissolve the precipitate in concentrated hydrochloric acid and add 1 mg lanthanum carrier and 5 ml hydrofluoric acid and stir with a plastic rod. Lanthanum fluoride precipitates. Centrifuge and discard the supernate.

6.3.3.5 Carry out the process described in **6.3.2.3** to **6.3.2.6** and get the count rate of the sample with background (N_s).

6.3.3.6 By subtracting the count rate of background from the count rate for sample and background the count rate for the sample (C_s) may be obtained.

6.3.3.7 Calculate the gross alpha activity (A_s) of the sample as follows:

Count rate of the sample mounted on the planchet (C_s) in counts per minute (cpm) = $N_s - (N_B + N_{LaF_3})$.

where

N_s = count rate in cpm of the sample and count rate of background in cpm;

N_B = background count rate in cpm; and

N_{LaF_3} = blank LaF_3 count rate in cpm.

Gross alpha activity of the sample (A_s) in Bq/unit

$$\text{sample} = C_s \times \frac{100}{E} \times \frac{1}{S}$$

where

E = the efficiency of alpha counter in percent;

C_s = the count rate of the sample in cpm; and

S = Sample size taken for counting.

ANNEX A

(Foreword)

COMMITTEE COMPOSITION

Nuclear Materials Sectional Committee, CHD 030

<i>Chairman</i>	<i>Representing</i>
DR K. BALARAMAMOORTHY	National Safety Council, Bombay
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Director (Chem)	

Member Secretary

SHRI P. MUKHOPADHYAY
Joint Director (Chemical), BIS

Codes of Practice for Safety and Surveillance Subcommittee, CHD 030 : 03

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